

CLAIMS

1. Endoscopic steering apparatus, comprising:

an endoscope, having distal and proximal ends thereof;

5 at least one proximal cylinder, disposed in a vicinity of the proximal end of the endoscope;

at least one proximal piston, slidably coupled to the at least one proximal cylinder;

10 a first distal cylinder, disposed at the distal end of the endoscope;

a first distal piston, slidably coupled to the first distal cylinder;

a second distal cylinder, disposed at the distal end of the endoscope;

15 a second distal piston, slidably coupled to the second distal cylinder;

a first tube, coupled to the first distal cylinder and to the at least one proximal cylinder;

20 a second tube, coupled to the second distal cylinder and to the at least one proximal cylinder; and

a linkage disposed at the distal end of the endoscope and coupled to the first distal piston and to the second distal piston, such that displacement of at least one of the distal pistons causes displacement of the linkage and steering of the distal end of the endoscope.

2. Apparatus according to claim 1, wherein the at least one proximal piston is adapted to be manually driven.

3. Apparatus according to claim 1, wherein the at least one proximal piston is adapted to be power driven.

4. Apparatus according to claim 1,

wherein the at least one proximal cylinder comprises respective first and second proximal cylinders,

wherein the at least one proximal piston comprises respective first and second proximal pistons, slidably
5 coupled to the first and second proximal cylinders, respectively,

wherein the first tube is coupled to the first distal cylinder and to the first proximal cylinder, and

wherein the second tube is coupled to the second
10 distal cylinder and to the second proximal cylinder.

5. Apparatus according to claim 1,

wherein the at least one proximal cylinder comprises a single proximal cylinder,

wherein the at least one proximal piston comprises a
15 single proximal piston, slidably coupled to the single proximal cylinder,

wherein the single proximal cylinder has a proximal port and a distal port, disposed at respective ends of the single proximal cylinder, and

20 wherein the first and second tubes are coupled to the single proximal piston at the proximal and distal ports, respectively.

6. Apparatus according to claim 1, wherein the linkage comprises a flexible element, disposed in the endoscope
25 such that tension in the element translates a displacement of one of the distal pistons into a change in angular disposition of the distal end of the endoscope.

7. Apparatus according to claim 1, wherein the linkage
30 comprises an element, disposed in the endoscope such that compression in the element translates a displacement of

one of the distal pistons into a change in angular disposition of the distal end of the endoscope.

8. Apparatus according to any one of claims 1-7, wherein the linkage is configured so as to translate a displacement of one of the distal pistons into a displacement of the other one of the distal pistons.

9. Apparatus according to any one of claims 1-7, and comprising a mechanical user-interface device, which is coupled to the at least one proximal cylinder so as to mechanically transduce a force generated by a user of the steering apparatus into a motion of the at least one proximal piston.

10. Endoscopic steering apparatus, comprising:

an endoscope, having distal and proximal ends thereof, the distal end comprising a forward section and a rear section flexibly coupled to the forward section;

a distal cylinder, disposed at the rear section of the distal end of the endoscope;

a distal piston, slidably coupled to the distal cylinder and coupled to the forward section of the distal end of the endoscope;

a proximal cylinder, disposed in a vicinity of the proximal end of the endoscope;

a proximal piston, slidably coupled to the proximal cylinder; and

a tube, coupled between the distal cylinder and the proximal cylinder, such that displacement of the proximal piston generates a pressure in the tube capable of displacing the distal piston and rotating the forward section with respect to the rear section.

11. Apparatus according to claim 10, wherein the proximal piston is adapted to be manually driven.

12. Apparatus according to claim 10, wherein the proximal piston is adapted to be power driven.

5 13. Apparatus according to claim 10, and comprising a mechanical user-interface device, which is coupled to the proximal cylinder so as to mechanically transduce a force generated by a user of the steering apparatus into a motion of the proximal piston.

10 14. Apparatus according to any one of claims 10-13, wherein the distal cylinder has a distal port, distal to the distal piston, in communication with the tube, such that positive pressure in the tube responsive to displacement of the proximal piston induces proximal
15 motion of the distal piston.

15. Apparatus according to claim 14,

wherein the proximal cylinder has a first port, which is in communication with a first face of the proximal piston, and a second port, which is in
20 communication with a second face of the proximal piston,

wherein the tube is coupled to the proximal cylinder at the first port, so as to be in communication with the first face of the proximal piston,

wherein the distal cylinder has a proximal port,
25 proximal to the distal piston,

wherein the apparatus comprises an additional tube having distal and proximal ends thereof, the additional tube being in communication at the distal end thereof with the proximal port of the distal cylinder, and being
30 in communication at the proximal end thereof with the second port of the proximal cylinder,

such that positive pressure in the additional tube responsive to displacement of the proximal piston induces distal motion of the distal piston.

16. Apparatus according to claim 14,

5 wherein the apparatus comprises an additional proximal cylinder, disposed in a vicinity of the proximal end of the endoscope,

wherein the apparatus comprises an additional manually-driven proximal piston, slidably coupled to the
10 additional proximal cylinder,

wherein the distal cylinder has a proximal port, proximal to the distal piston,

wherein the apparatus comprises an additional tube, coupled between the proximal port of the distal cylinder
15 and the additional proximal cylinder,

such that positive pressure in the additional tube responsive to displacement of the additional proximal piston induces distal motion of the distal piston.